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ORIGINAL PAPER

Shared responsibility and social vulnerability in the 2011 Brisbane flood

Pamela Box[1] · Deanne Bird[2] · Katharine Haynes[2] · David King[3]

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Abstract In January 2011, Brisbane, Australia, experienced its first significant flooding in almost four decades. This paper presents the results of a questionnaire conducted in four affected inner western suburbs 7 months after the flood. These locations were specifically chosen as the residents within these communities come from a range of demographic, social, and economic backgrounds. The research utilised a mixed methods approach involving a quantitative questionnaire and qualitative interviews. This paper examines residents' experience of the flood, their thoughts on risk reduction and insurance, what factors helped or hindered response and adaptation to flood risk, and how to articulate shared responsibility for reducing flood risk. Assessing gender, age, income, and previous flood experience, it finds that those with previous flood experience were more likely to have flood insurance but less likely to have taken precautions to prepare for the flood. While almost three-quarters of respondents said they were aware of the flood risk when they moved to the area, they were nonetheless surprised by and largely unprepared for the 2011 flood. The implications of these findings for future flood risk reduction are discussed.

Keywords Adaptation · Risk reduction · Flood hazard · Disaster

1 Introduction

Extreme weather is one of the defining images of Australia. The Australian floods of 2010–2011 affected every state and territory and attracted international attention. After a decade-long drought, they refocused attention on the other end of the weather spectrum. In

✉ Pamela Box
pamelambox@gmail.com

[1] Department of Environment and Geography, Macquarie University, Sydney, NSW, Australia

[2] Risk Frontiers, Macquarie University, Sydney, NSW, Australia

[3] Centre for Disaster Studies, James Cook University, Townsville, QLD, Australia

the 6 months from November 2010 to April 2011, over 90 % of Queensland was disaster-declared due to flood (QRA 2011). The flooding of Brisbane in January 2011 was the most significant during this period with an estimated 18,000 properties in Brisbane and surrounds experiencing some level of inundation (van den Honert and McAneney 2011).

Brisbane is situated on a floodplain, with numerous floods recorded since the establishment of a settlement in 1824. The Australian Bureau of Meteorology has a comprehensive list of those floods (Bureau of Meteorology 2013). The most significant flood in recent history had been that of 1974, when the Brisbane River reached a peak of 5.45 m at the city gauge (van den Honert and McAneney 2011). The January 2011 flood was the first major flood since 1974, but the city had previously experienced many minor and moderate floods, and three major floods in the nineteenth century. Those floods, in 1841, 1844, and 1893, were considerably higher than the 2011 flood, with all three reaching heights above 7 m (Brisbane City Council 1999, pg 5), whereas the 2011 flood only reached 4.46 m at the city gate (van den Honert and McAneney 2011). Brisbane has a high flood risk with an estimated 18,000 properties within the '1 in 100' flood zone (Leigh 2006), making flood knowledge amongst the community a crucial component of preparedness.

In terms of management of hazard events, the Australian National Strategy for Disaster Resilience, drafted in 2009 and adopted in 2011, describes hazards as a *shared responsibility*, stating that:

> A disaster resilient community is one that works together to understand and manage the risks that it confronts. Disaster resilience is the collective responsibility of all sectors of society, including all levels of government, business, the non-government sector and individuals. If all these sectors work together with a united focus and a shared sense of responsibility to improve disaster resilience, they will be far more effective than the individual efforts of any one sector. (Attorney General's Department 2009, pg 4).

This concept of the importance of involvement from multiple stakeholders was described as a 'holistic approach' in DEFRA's 'Making Space for Water' report (DEFRA 2005). Walker and Bickerstaff (2002) analysed discourses of blame for air pollution, finding attribution of responsibility to other parties a common way individuals deflect any personal responsibility for pollution and its impacts. Research by Eburn and Dovers (2012) into views of shared responsibility for bushfire found that the concept was viewed more as the need for government and emergency management agencies to tell residents what to do, rather than engaging with residents to share the management of risk. But a move towards shared responsibility is a move away from a government-centric approach (Johnson and Priest 2008) and ideally moves away from the blame shifting identified by Bickerstaff and Walker. McLennan and Handmer (2012a) have created what they describe as a responsibility continuum for risk management, moving from self-reliance to central authority through the 'domain of responsibility-sharing' (McLennan and Handmer 2012a, pg 3), which stresses the importance of collective action while also acknowledging the varying capacities and roles of each stakeholder. In other research, they note the importance of recognising that shared responsibility is not just about improving local self-reliance, but also better cross-agency coordination (McLennan and Handmer 2012b). This paper, however, focuses on the first element of individual self-reliance and preparedness.

However, are communities sharing the responsibility in reducing flood risk? If not, how can we better articulate the responsibilities of each stakeholder—including individual residents—to encourage them to take their own steps to prepare for flood? This paper uses Brisbane's flood experience as a case study to examine whether residents perceive and have taken a share of the role in this responsibility. To achieve this, the paper examines

residents': knowledge of flood risk; response to the 2011 event; insurance coverage for flood; information needs; and opinions of potential strategies that might enable households and stakeholders to reduce future vulnerability. Emergency Management Australia describes three categories of vulnerability influencers: economic factors; personal factors; and locational factors (Emergency Management Australia 2002). Brisbane, of course, is locationally vulnerable to flood. This study seeks to quantify the role of key economic and personal factors—gender, age, income, and flood knowledge—on their preparedness for flood.

Flood insurance is a way for residents to share the financial responsibility for flood. In Australia, insurance has not typically included riverine flood in standard cover (ASIC 2000). Standard policies have covered storm and flash flooding, but there was variation in claims' outcomes between insurance policies (Carter 2012). Confusion over definitions of flood and sources of inundation has been debated (Smith and Handmer 2002). At the time of the research, there was ongoing discussion of insurance issues both nationally and for individual respondents, including respondents awaiting the outcome of claims or disputing insurance companies' decisions, as well as significant and often negative media coverage of insurers' responses to the flood. The Australian Securities and Investments Commission reported following multiple floods throughout the 1990s, recommending better information and education from insurers about what is and is not included in a customer's policy (ASIC 2000). Given this context, the ability of insurance to financially prepare residents for flood costs, and controversy around insurance cover following the Brisbane flood, insurance has been included as a key issue in this paper.

An accurate awareness of local flood risk is crucial to sharing responsibility and reducing vulnerability. In Brisbane, inaccurate understandings of water infrastructure were noted. Wivenhoe Dam, proposed in 1971 and then built for water storage and flood mitigation in the aftermath of the 1974 flood (Grigg 1977), does not 'flood-proof' the city, although many residents assumed that it would prevent floods. Given Brisbane's history and location, it will continue to experience significant rainfall and flood events into the future. Moreover, the costs of natural disasters are likely to continue increasing with population growth in at-risk areas (Crompton and McAneney 2008), including south-east Queensland, increasing the importance of clear understanding of and preparation for flood.

2 Flood experience and social vulnerability

Factors of socio-economic disadvantage and past experience can affect residents' preparedness and responses to hazard events. Adger (2006) describes vulnerability to natural disasters as being based not only on exposure to a particular hazard, but also on the availability of coping resources. Those groups who are generally more vulnerable are the elderly and very young, those with lower incomes, and women (Cutter 2010). Following Hurricane Katrina, while the damage of the storm was relatively uniform across demographics, those with lower incomes were less likely to have evacuated or had flood insurance (Masozera et al. 2007). In the UK, the most disadvantaged 20 % of the population are significantly over-represented in areas at risk of flooding, with women and the elderly suffering greater adverse impacts (Walker and Burningham 2011). The oldest and youngest age groups can also be placed at higher risk by sheltering in place during floods (Haynes et al. 2009). As age, gender, and income have been found to influence vulnerability in other studies and locations, these variables were selected for this study. In

addition, lack of insurance has been identified as potentially increasing vulnerability (Dwyer et al. 2004), was the focus of significant media attention during the 2010–2011 floods, and has been included as a further variable.

The impact of various socio-economic and cognitive factors on flood preparedness is not clear-cut. A post-flood survey in south-east Queensland found no correlation between either perception of risk or income and flood insurance (Lo 2013). However, this study was region-wide, rather than specific to those affected by the floods, and therefore, the impact of flood experience could not be identified. Thieken et al. (2006) found higher rates of insurance cover, mitigation, and information acquisition in households with previous flood experience, and Grothmann and Reusswig (2006) found correlation between age, income, and previous flood exposure, and seeking flood information and personal protective actions. A Swiss study found those with flood experience were both more likely to have taken preparedness measures and less likely to think they were prepared for flood (Siegrist and Gutscher 2008). By contrast, research following a 1997 flood in Manitoba, Canada, found that previous flood experience can be beneficial in preparedness, but is largely useful when that previous experience was recent (Burn 1999), while a study in New Zealand found no link between experience and preparedness (Gregory et al. 1997). Research in Cairns, Queensland, also found no links between socio-economic indicators and flood awareness and preparedness (King 2001), and a Texan study found that, while older residents were more likely to have been flooded, they reported lower levels of stress (Tobin and Ollenburger 1992).

This study also discusses respondents' knowledge of flood and perceptions of responsibility for flood preparedness. Risk perception is complex, with perceived and actual risk often misaligned. Perceptions are influenced not only by facts, but by experience, media coverage, and personal judgement of one's capabilities (Slovic 1987, 1999, McClure 2006). Responsibility for preparedness and response to natural hazards is often seen as the job of 'someone else', i.e. the local council, emergency services, the federal government (McPherson and Saarinen 1977; Paton 2003; McLennan and Handmer 2012a; Box et al. 2013), or as too complex for the wider community (Godschalk et al. 2003). This is described by Dufty (2007) as transfer of responsibility and can lead to inertia on the part of individuals—waiting to be evacuated, waiting to be doorknocked, etc. There is also a desire and even expectation for risks to be contained and controlled. As described by Burton et al. (1968), there is an expectation that authorities have 'a social responsibility to cushion all members of society against unexpected events' (pg 4). There has been a shift in more recent years to encourage communities to understand their local risk and greater involvement of local residents and communities in hazard management decisions (Brown et al. 1995; Ramirez 1999; Pearce 2003). Even in studies where individuals list themselves as having a predominant responsibility to prepare themselves for flood, some respondents still place almost all responsibility for flood preparedness on local and state governments (Keogh et al. 2011).

The importance of clear flood information has also been emphasised in the National Strategy for Disaster Resilience (Council of Australian Governments 2011) and the enquiries into the Victorian (Comrie 2011) and Queensland (Queensland Floods Commission of Inquiry 2011) floods. But information about hazards is not interpreted equally by all individuals (Kellens et al. 2012). Some vulnerable populations may not have the same access to or ability to understand hazard information (Vaughan 1995). In discussing earthquake risk in New Zealand, McClure et al. (2011) found that residents of Christchurch had not considered themselves at risk, whereas residents of Wellington, a city with more earthquake education, were much more likely to consider an earthquake likely to occur.

Noting these facts, this study examines whether flood knowledge and interest in particular sources of flood information vary based on factors of gender, age, and income, and if these affect vulnerability.

3 Methodology

Data collection involved both a questionnaire and semi-structured interviews with residents of the inner western Brisbane suburbs of Chelmer, Graceville, Tennyson, and Rocklea (see Fig. 1), along the southern shore of the Brisbane River. These suburbs were selected to represent varied demographics, with Rocklea being a younger and less affluent area, Tennyson and Chelmer older and more affluent, and Graceville in between (ABS 2013).

Purposive sampling was chosen as the central criterion for participation in this study was direct experience of the 2011 flood. Residents who had moved to the area following the flood were excluded from the study. Doorknocking was chosen in order to provide residents with an opportunity to discuss their experience in more detail while allowing researchers to observe damage first-hand. In general, the questionnaire covered how the flood impacted residents and what factors helped or hindered their ability to protect their properties from flood, and what they think about flood risk. Specific questions focused on demographics, the impact of the flood on their property, awareness of flood risk, the state of their insurance coverage at the time of the flood, what information residents desired to have about flood risk, and their thoughts on how to reduce the risk. Most questions were

Fig. 1 Location of questionnaire area, Brisbane city is to the north-east of the map

closed, asking residents to select the option that best reflected their opinion or experience. However, options of 'other, please specify' and 'please comment' were included to avoid limiting responses. Open questions on opinions of how various stakeholders could reduce flood risk were also included.

Between 29 August and 3 September, 2011, 430 residences on streets affected by the 2011 flood were doorknocked between the hours of 10 a.m. and 12 p.m., and 2 p.m. and 3 p.m. If home, residents were given a hardcopy of the questionnaire for collection the following day or at an alternate time as specified by the resident. Alternatively, residents were given the option to complete the questionnaire online. Houses where no resident was home were not returned to due to time constraints, nor were questionnaires left at those addresses. The authors acknowledge this as a limitation to the size and coverage of this study. During the doorknocking process, many residents took the opportunity to discuss their flood experience. Where permitted, an audio device was used to record these discussions. These interviews provide valuable qualitative data in the form of quotes, some of which are used throughout this paper.

Occupants were home at 110 or 26 % of the residences. Of those, 72 agreed to participate, a provisional participation rate of 66 %. Thirty-four people took a hardcopy of the questionnaire, while 38 gave their email address and were later sent a link to the website SurveyMonkey, where they could complete the questionnaire up until the end of September 2011. Sixty-two completed questionnaires were received, giving a response rate of 86 %. This is a small sample not only for the study area, but of the greater Brisbane flood zone, and so it should be noted that this limits how much the results presented here can speak for the flood-affected residents of Brisbane as a whole.

The 320 residences where nobody answered were divided into three categories: absent, empty, and abandoned. 'Absent' was used for addresses that appeared to be occupied, 'empty' was for addresses where it appeared nobody was currently living, but the property was in some stage of repair or up for sale or rent, and 'abandoned' was reserved for houses that clearly had not been returned to—locked gates, mud-caked walls, overgrown gardens, etc. Two hundred and thirty-five residences or 73 % were categorised as 'absent', 69 residences or 22 % were categorised as 'empty', and 14 residences or 4 % were categorised as 'abandoned', making just over one-quarter of properties unoccupied. The percentage of absent residents was close to uniform across the four suburbs, but variation existed in the other categories. Twenty-two per cent of residences were 'empty' in Graceville, the highest rate. The highest rate of abandoned residences was 8 % in Tennyson, with no abandoned homes in Chelmer.

4 Results

4.1 Questionnaire findings

In the following sections, results are analysed by gender, income, age group, and previous flood experience. These categories were chosen as previous studies have suggested they can influence residents' awareness and flood actions (see Weinstein 1989; Kellens et al. 2012; Hansson et al. 1982; Burningham et al. 2008). As this study uses only self-reported data, the potential for some responses to be inaccurate—either accidentally or deliberately—is acknowledged.

4.2 Demographics

The largest proportion of respondents was from Chelmer (28 %), 21 % were from both Rocklea and Tennyson, 16 %were from Graceville, and 13 % did not indicate their suburb. Table 1 shows the demographic spread across the questionnaire area. Percentages are given for all categories, and raw numbers are also given for the number of respondents from each suburb. When the questionnaire data are compared to 2011 census statistics (ABS 2013), the two suburbs with the lowest median age also have the highest proportion aged under 45, and Rocklea, with the lowest median weekly income, has a notably smaller percentage of respondents with household incomes above $100,000. Seventy-four per cent of residents had no previous flood experience, and 26 % said they had experienced flood previously. Of those with previous flood experience, 38 % listed the 1974 Brisbane flood as their previous experience. Chi-squared tests were performed, finding statistically significant correlations between income and experience ($p < 0.02$), and age and experience ($p < 0.01$), with those residents who had experienced flood prior to January 2011 more likely to be over 65 and have incomes below $50,000.

4.3 Knowledge of flood risk and flood preparation

The questionnaire first sought to discover residents' knowledge of flood risk. Residents were asked: *When you purchased/started living in your home were you aware it was vulnerable to flood?* The majority of those questioned (73 %) said they were aware of the flood risk when they moved to their current address (Fig. 2). Income and gender had no impact on resident's awareness of flood risk, but those with previous flood experience (56 %) and aged 65 and over (54 %) were less likely to have been aware of the risk when they moved to their current address. While the question asked about their awareness prior to the January 2011 flood, it is possible that some of those who answered that they were aware were influenced by hindsight of their experience.

While the majority said they were aware their location was at risk of flood, many had assumed the Wivenhoe Dam would protect them from flood. One resident remarked 'we

Table 1 Demographics by suburb

	Chelmer	Rocklea	Tennyson	Graceville	Not listed	Total
Respondents	28 % (17)	21 % (13)	21 % (13)	16 % (10)	13 % (8)	100 % (61)
Female	47 % (8)	69 % (9)	54 % (7)	40 % (4)	75 % (6)	56 % (34)
Male	53 % (9)	31 % (4)	46 % (6)	60 % (6)	25 % (2)	44 % (27)
No flood experience	76 % (13)	69 % (9)	69 % (9)	70 % (7)	87 % (7)	74 % (45)
Flood experience	24 % (4)	31 % (4)	31 % (4)	30 % (3)	13 % (1)	26 % (16)
Age: under 45	29 % (5)	46 % (6)	38 % (5)	50 % (5)	50 % (4)	41 % (25)
Age: 45–64	41 % (7)	31 % (4)	46 % (6)	30 % (3)	37 % (3)	34 % (21)
Age: 65 and over	29 % (5)	23 % (3)	23 % (3)	20 % (2)	–	21 % (13)
Income: under $50,000	18 % (3)	31 % (4)	31 % (4)	30 % (3)	13 % (1)	25 % (15)
$50–100,000	24 % (4)	46 % (6)	–	20 % (2)	62 % (5)	30 % (18)
Over $100,000	35 % (6)	8 % (1)	38 % (5)	30 % (3)	13 % (1)	26 % (16)
Don't want to say	24 % (4)	15 % (2)	31 % (4)	20 % (2)	13 % (1)	20 % (12)

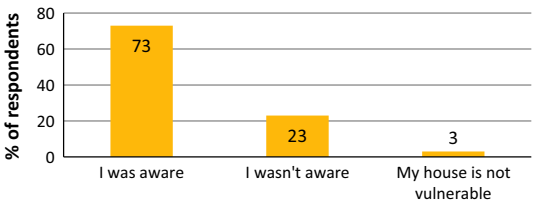

Fig. 2 Awareness of risk when moved to current address

bought this house with the understanding that Wivenhoe would protect it, protect here'. One respondent wrote they were 'foolishly convinced it would not reach previous levels as dam would be used to manage flooding', another wrote that they 'knew it flooded back in 1974 and were under the impression that it would not happen again as they had built Wivenhoe Dam as flood mitigation'. Others misunderstood the '1 in 100' flood terminology—thinking this meant another flood was not 'due' to happen for more than 50 years, given the last major flood was <40 years earlier.

Respondents were then asked: *What was the most valuable source of information about flood risk?* To which seven options were provided: local government; emergency services; friends/family/neighbours; community groups; media; personal experience; and other (see Table 2—please note, no respondents selected emergency services or community groups, so those categories have been omitted). For 'other', two respondents mentioned awareness of the 1974 flood, five listed doing their own private research, and one was informed of their flood risk by their solicitor. Those with previous flood experience equally cited local government, friends/family/neighbours, and personal experience (i.e. 27 % each category), while those without previous flood experience most valued information about flood risk from friends/family/neighbours. The sample size was too small to be statistically significant, but personal experience was more valued by respondents aged 65 + years, and information from friends and family was more valued by women, younger people, and those on middle incomes.

Residents were asked what actions they took to protect their family and/or household before or during the 2011 flood (Table 3). Those with no previous flood experience took more actions, an average of 3.18 per respondent, than those with previous flood experience,

Table 2 Most valuable sources of flood information

Information sources	Local government	Friends/family/ neighbours	Media	Personal experience	Other
Female	29 % (6)	48 % (10)	5 % (1)	10 % (2)	10 % (2)
Male	16 % (3)	26 % (5)	5 % (1)	21 % (4)	32 % (6)
No flood experience	20 % (7)	43 % (15)	9 % (3)	9 % (3)	20 % (7)
Flood experience	27 % (3)	27 % (3)	0 %	27 % (3)	18 % (2)
Age: under 45	22 % (4)	50 % (9)	0 %	5 % (1)	22 % (4)
Age: 45–64	24 % (4)	29 % (5)	18 % (3)	6 % (1)	24 % (4)
Age: 65 and over	20 % (2)	40 % (4)	0 %	40 % (4)	0 %
Income: under $50,000	25 % (3)	30 % (4)	0 %	25 % (3)	17 % (2)
$50,000–100,000	15 % (2)	54 % (7)	15 % (2)	8 % (1)	8 % (1)
Over $100,000	20 % (2)	40 % (4)	10 % (1)	0 %	30 % (3)
Average	22 %	39 %	7 %	13 %	20 %

Table 3 Actions taken by residents before/during flood

Action taken	Evacuated	Flood-resilient building	Evacuation plan	Evacuation kit	Followed warning advice	Sandbag home	Cleared drains	Raised items
Female	62 % (21)	6 % (2)	12 % (4)	12 % (4)	41 % (14)	12 % (4)	9 % (3)	62 % (21)
Male	59 % (16)	7 % (2)	37 % (10)	15 % (4)	44 % (12)	15 % (4)	7 % (2)	59 % (16)
No flood experience	60 % (27)	9 % (4)	29 % (13)	16 % (7)	44 % (20)	18 % (8)	11 % (5)	64 % (29)
Flood experience	63 % (10)	0 %	6 % (1)	6 % (1)	38 % (6)	0 %	0 %	50 % (8)
Age: under 45	72 % (18)	8 % (2)	24 % (6)	16 % (4)	56 % (14)	16 % (4)	12 % (3)	68 % (17)
Age: 45–64	48 % (10)	10 % (2)	33 % (7)	14 % (3)	27 % (6)	19 % (4)	5 % (1)	52 % (11)
Age: 65 and over	62 % (8)	0 %	8 % (1)	0 %	38 % (5)	0 %	8 % (1)	62 % (8)
Income: under $50,000	67 % (10)	13 % (2)	20 % (3)	22 % (4)	47 % (7)	7 % (1)	7 % (1)	60 % (9)
$50,000–100,000	61 % (11)	6 % (1)	17 % (3)	22 % (4)	11 % (2)	17 % (3)	11 % (2)	67 % (12)
Over $100,000	69 % (11)	6 % (1)	25 % (4)	13 % (2)	44 % (7)	25 % (4)	6 % (1)	56 % (9)
Average	60 %	7 %	23 %	13 %	42 %	13 %	8 %	65 %

who took an average of 2 actions each. Minimal variation is seen when the results are analysed by income, except for the middle income group being less likely to have followed warning advice. Those in the younger age group were most likely to have evacuated and followed warning advice, with the oldest age group undertaking the fewest preparations. While men were more likely to have an evacuation plan, there was no difference in evacuation rates between genders. Again, statistical tests were carried out, but the sample sizes were too small to be significant.

4.4 Flood insurance knowledge and cover

Respondents were asked about their insurance cover at the time of the flood, as well as whether or not they had since changed it, or planned to change it. The first question aimed to gauge the level of flood insurance penetration amongst study participants: *Please indicate which of the following most accurately describes your knowledge of your insurance cover prior to the 2011 flood*. Respondents selected from four responses: I knew my insurance covered me for all types of flood; I thought my insurance covered me for all types of flood; I knew my insurance covered me for storm flood only; and I knew I did not have any insurance cover at the time of the flood. Twenty-five percentage of those with flood experience and 33 % of those with no flood experience had thought their insurance covered them for all types of floods (Table 4). The results were too small to be statistically significant, but show a slight tendency for those with previous flood experience to be more aware of what their insurance covered. When assessed by age, those over 65 were most likely to have full cover and least likely to have no insurance, while the youngest age group was most likely to have thought their insurance covered them for all types of flood. Those with higher incomes were both most likely to have full flood cover and most likely to have thought they had full cover. Insurance cover was also assessed by home ownership status, comparing renters to those who owned or had a mortgage on their property. The majority of renters had no insurance (71 %), and no renter had full flood insurance. It should be noted, however, that only 7 respondents were renting, so no conclusion can be drawn from these percentages.

Table 4 Respondent's insurance status at the time of the flood

	All flood	Storm only	No insurance	Thought I was covered
Female	22 % (7)	16 % (5)	28 % (9)	34 % (11)
Male	27 % (7)	23 % (6)	19 % (5)	31 % (8)
No flood experience	20 % (9)	18 % (8)	20 % (9)	33 % (15)
Flood experience	31 % (5)	19 % (3)	25 % (4)	25 % (4)
Age: under 45	20 % (5)	20 % (5)	24 % (6)	36 % (9)
Age: 45–64	24 % (5)	14 % (3)	24 % (5)	24 % (5)
Age: 65 and over	31 % (4)	23 % (3)	15 % (2)	31 % (4)
Income: under $50,000	13 % (2)	27 % (4)	33 % (5)	27 % (4)
$50–100,000	17 % (3)	22 % (4)	28 % (5)	22 % (4)
Over $100,000	25 % (4)	13 % (2)	–	50 % (8)
Average	23 %	18 %	21 %	33 %

A follow-up question was asked to those without full flood cover ($n = 47$): *If you did not have insurance prior to the 2011 flood, why?* Respondents selected answers from: didn't think I needed it; too expensive; I thought it wasn't available; it wasn't available; I thought I was covered; or other, where they could then give further detail. Cost was regularly singled out as the biggest reason for not having insurance (Table 5). One resident said he had been quoted $6000 a year for cover, which he judged beyond his ability to pay. Cost was particularly prohibitive for women, those with flood experience, and the younger and middle aged groups, although it should be noted that this question was only answered by a subset of respondents, and so, results cannot be taken as conclusive for the wider community. Those with high incomes were most likely to have thought their insurance covered them for all types of flood. In giving their reasons for not taking out cover, some residents indicated they did not trust insurance companies, describing them variously as 'bastards', 'morally corrupt', and 'thieving mongrel lousy guys'. One respondent commented he felt insurers wrote policies in unclear language so they could 'wangle their way out'. While negative media coverage may have influenced residents' opinions of insurance companies, many of these responses came from residents whose insurance claims had been rejected.

A third insurance question asked: *Since the 2011 flood, have you updated or purchased an insurance policy for all types of flood?* Some residents commented they were waiting for insurance decisions to be finalised, or were investigating upgrading their cover, one writing 'will be purchasing tomorrow—full flood cover'. No demographic difference was observed between any of the categories.

4.5 Residents' thoughts on risk reduction

Residents were asked what they thought could be done by the council, and SES, as well as what they felt were the best options overall to reduce flood risk. While residents were able to give up to three responses, some gave one, two, or no suggestions. As these questions were open-ended, a wide array of responses was received. This section will discuss some of the common issues raised.

Table 5 Reasons why residents did not have flood insurance

	Didn't think I needed it	It wasn't available	Too expensive	Thought it wasn't available	Thought I had insurance	Other
Female	15 % (2)	8 % (1)	54 % (7)	8 % (1)	15 % (2)	–
Male	8 % (1)	17 % (2)	17 % (2)	8 % (1)	17 % (2)	33 % (4)
No flood experience	16 % (3)	11 % (2)	32 % (6)	5 % (1)	16 % (3)	21 % (4)
Flood experience	–	17 % (1)	50 % (3)	17 % (1)	17 % (1)	–
Age: under 45	15 % (2)	–	46 % (6)	–	31 % (4)	8 % (1)
45–64	11 % (1)	11 % (1)	33 % (3)	11 % (1)	–	33 % (3)
65 and over	–	50 % (2)	–	25 % (1)	25 % (1)	–
Income: under $50,00	13 % (1)	25 % (2)	38 % (3)	13 % (1)	–	13 % (1)
$50,000–100,000	22 % (2)	11 % (1)	33 % (3)	11 % (1)	11 % (1)	11 % (1)
Over $100,000	–	–	–	–	67 % (2)	33 % (1)
Average	12 %	12 %	36 %	8 %	16 %	16 %

Residents were first asked: *What are the three main things you think can be done from a council perspective to help reduce your risk from future flood?* There were four main suggestions for council: Wivenhoe Dam (32 % of responses), flood information and mapping (17 %), improving storm water drainage (15 %), and regulations such as land use planning (8 %). Others made suggestions about Oxley Creek, which empties into the Brisbane River facing upstream (see Fig. 1), causing backup flooding into suburbs such as Rocklea. Some residents suggested widening the Creek mouth, 'so that the River doesn't think that Oxley Creek is the river to flow straight into', while another suggested 'build a groyne to stop Bris River flowing straight up the Creek'. Other responses concerned sandbagging, building levees, and clearing the Brisbane River of debris.

The second question concerned the response of emergency services: *What are the three main things you think can be done from an emergency service (e.g. SES) perspective to help reduce your risk from future flood?* Fewer responses were given for this question. While 25 % of respondents wanted better early warning, some residents made suggestions that were not emergency services' responsibilities, with 13 % of suggestions concerning the running of Wivenhoe Dam or land use planning. A few residents expressed satisfaction with the SES, saying they were 'good', 'did all they could', and even 'they were brilliant!' 9 % suggested more volunteers and resources as one way the SES could improve for the future, and 7 % called for general information and education. The responses asking for more information and warnings suggest that residents wanted to do more themselves but felt they did not have adequate knowledge to do so.

The final of the three questions was: *What do you think are the three best measures or strategies to help reduce your risk from future flood?* This question allowed residents to state which issues they felt were most important and also gave them the opportunity to suggest any steps they could take themselves to reduce their risk. Management of Wivenhoe Dam (27 %) and early warnings (14 %) were the most commonly raised issues, making up almost half of all responses. One resident wrote 'Have the brains to realise Wivenhoe needed controlled releases well before Jan 11. Do you need to be a hydrologist to work this out?' Other suggestions included raising homes, moving, or using flood-resilient building materials, and only 4 % of responses mentioned having 'appropriate insurance', but most respondents did not suggest actions they could personally take.

4.6 Information desired

Residents were asked: *What information would you like to be available on flood risk in your area?* Residents could select as many options as they wanted from the list of: flood maps; flood studies; brochures; media campaigns; flood/disaster page on council website; and council newsletter (Fig. 3). It should be noted that Brisbane City Council already had flood maps and studies available on their flooding web page, along with further tips on flood risk and preparation. While some residents indicated they were aware of this information's availability, the broader responses suggest information is being under-utilised. Those in the youngest age group were most interested in both maps and a web page (75 % and 62 %, respectively), with the oldest age group least interested in those information types, at 46 and 23 %, respectively. In comparison, respondents 65 years and over were most interested (46 %) in information being available via media campaigns. There were few differences in responses from men and women, except for a higher interest in brochures and newsletters from women compared to men (32 % each for women, 19 and 7 %, respectively, for men).

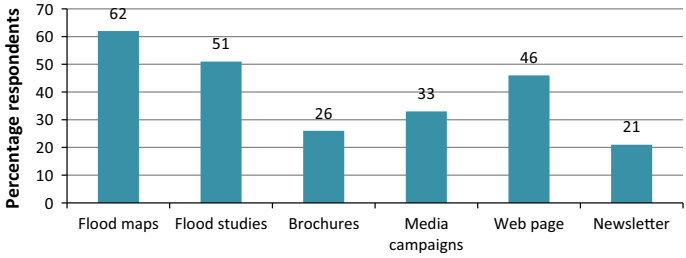

Fig. 3 Information types desired by residents

5 Discussion

The 2010–2011 floods prompted a number of reviews and enquiries, with state reviews in both Queensland (QFCI 2012) and Victoria (Comrie 2011), the federal Natural Disaster Insurance Review (Commonwealth of Australia 2011), and a review by the Brisbane Council of their flood response (Joint Flood Taskforce 2011), amongst others. All these reviews examined the role and response of governmental, emergency service, and insurance stakeholders, but largely bypass discussing the responsibility of residents, barring some comments about ensuring information is accessible to the local community. This view of the public as simply recipients of information has been critiqued in the context of both the 2010–2011 floods and the Black Saturday bushfires (Nicholls 2012). The one exception is the National Strategy for Disaster Resilience (Attorney General's Department 2009) and adopted by the Council of Australian Governments in late 2011, which calls for shared responsibility for all stakeholders, including the local community. It provides general principles and aims and describes the importance of a 'shared sense of responsibility to improve disaster resilience' (Attorney General's Department 2009, pg 4), but there is a need for research and consultation amongst all stakeholders to better define how this works in practice.

The sample size of this study limits what conclusions can be drawn, but the categories that showed higher vulnerabilities—the youngest and oldest, women, and those on lower incomes—have been identified by other researchers as having higher levels of vulnerability due to lower mobility and material capacity to prepare for and respond to hazard events (Cutter 2010). Walker and Burningham (2011) found similar results in the UK and also found gaps between official recovery actions and the needs and desires of residents, something some Brisbane residents also alluded to, particularly regarding how council and SES could reduce future risk.

In terms of financially preparing for flood, women, those on lower incomes, and the young, were less likely to have insurance and more likely to find it too expensive. The only positive correlation for flood insurance was previous flood experience. Previous research has suggested that insurance is viewed not as a necessary item but as a luxury (Sheehan and Renouf 2006), resulting in individuals exposed to both the physical and financial risks of flood. Flood insurance received significant media coverage during and after the flood. It included anger at rejected payouts (for example, Priest et al. 2011; Johnston et al. 2011; Gillard 2011), as well as calls for companies to be 'compassionate' and provide ex gratia payments (Bligh 2011). Negative attitudes to insurance were evident in the questionnaire responses and interviews, and anti-insurance banners were observed hanging from multiple houses. With one-third of respondents being mistaken about their insurance cover, such attitudes are unsurprising.

A new single definition of flood for insurance purposes has been adopted to address some of the misperceptions around insurance cover. This move was supported and proposed by the Insurance Council of Australia (ICA 2011). The new regulation, made in June 2012, defines flood as:

> the covering of normally dry land by water that has escaped or been released from the normal confines of: any lake, or any river, creek or other natural watercourse, whether or not altered or modified; or any reservoir, canal, or dam.

(SLI 2012 No. 116) A number of residents expressed confusion about what sort of water damage were covered by their insurance, so uniform terminology should address that particular concern. At least one academic paper published following the flood has agreed with public and media suggestions that insurers have done an inadequate job in outlining what is and is not covered by different policies (Tarr 2011), leaving some residents unaware they were financially unprepared. Some residents who had no insurance had made that decision based on mistrust of insurance companies, but had nonetheless prepared for the flood. Those residents generally had more positive stories about their experiences and had been more proactive in the lead-up to the flood, in contrast to those who thought their insurance covered them for flood. Flood insurance needs to play an increased role in risk reduction, with premiums encouraging people in risky locations to undertake all actions possible to reduce their risk and cost.

One key finding of this research was the contrast between the high proportion of respondents who stated they were aware their property was on a flood plain and the lower proportion of respondents who had made personal preparations. The Natural Disaster Insurance Review 'Consumer Perspective' paper recommended information be available not only on public websites such as local councils, but also be listed on yearly rates notices, provided on insurance policies and renewal letters, and provided when a property is leased or purchased (Connolly 2011). This would put flood information in front of residents on a regular basis. It also favoured automatic inclusion of flood cover with no 'opt-out', i.e. no possibility to have insurance that did not include flood cover, but also asks for government and industry to 'improve the affordability' of insurance (Connolly 2011). This returns to questions of how different responsibilities are distributed amongst the various stakeholders, and where the financial responsibility for residing in flood-prone areas lies. While this is beyond the scope of this particular paper, it is an area in need of further research.

In discussing risk reduction options, some residents recognised their role in flood preparation and response. This was seen in the comments for more information and more warnings, suggesting residents rely on council and emergency services for preparedness and response information. Another theme was discussion around restrictions and controls on building in flood-prone areas. While not raised by any respondents to this study, the Queensland Flood Commission (QFCI) recommended buyback schemes be implemented and funded by the National Disaster Resilience Program (QFCI 2012, pg 275). Brisbane Council had a buyback scheme in the years before the 2011 flood, but the strict qualification criteria, requiring there to be 'no other viable infrastructure solution' (BCC 2011, pg 1), worked against it. Only 55 of 525 eligible houses were purchased in the buyback scheme. In the 2 years following the 2011 flood, Brisbane Council has purchased 38 properties (Brisbane City Council 2013).

If residents perceive governments and public agencies as solely responsible for protecting them from flood, they are less likely to take personal precautions (Grothmann and Reusswig 2006), continuing to expect disaster protection from government in addition to their own preparations (Terpstra and Gutterling 2008; Keogh et al. 2011). This expectation

presents difficulties for emergency service organisations such as the SES who, as a largely voluntary organisation, are limited in what they can do in a flood of the scale of Brisbane. Two respondents called for an increased number of SES volunteers, and the same recommendation was made by the QFCI (QFCI 2011, pg 16). Any push for shared responsibility needs to include a public understanding of the abilities and limitations of emergency services in disaster situations, including limited personnel, with previous research finding almost three-quarters of surveyed people had expected individual official warnings before the Black Saturday fires (Whittaker et al. 2013). Lack of personnel, and the potential for carrying out evacuations to put emergency workers at risk, is a concern for flood response in Australia (Haynes et al. 2009). Concern about inadequate or non-existent warnings from emergency services has been raised after previous disasters in Australia (Gissing et al. 2010). More recently, a study of community and emergency management stakeholders on the Sunshine Coast in Queensland, Australia, found that while stakeholders do see the three tiers of government as responsible for coordination, infrastructure, and institutional elements of emergency management, there is also a recognition of the need to engage local communities in disaster resilience (Singh-Peterson et al. 2015). As such, there is a need to reframe these discussions to the 'united focus' the NSDR (Attorney General's Department 2009) proposes, over the current state of individual stakeholders working only from their own framework.

Flood planning decisions in Australia are made at a local government level. As such, there is a wide range of policies, as well as varying levels of flood information availability (Box et al. 2012). The Queensland Flood Commission noted both this variation and lack of a single location for flood studies and maps, and recommended the creation of one repository for such studies (QFCI 2012, pg 58). The variability of flood information across the country is now being addressed by the National Flood Risk Information Project (NFRIP), hosted by Geoscience Australia. All sources of information listed in the 'information desired' question were already available from Brisbane Council, although they have come in for criticism—including by some of the participants of this questionnaire—for allowing development in known flood risk areas and for their website crashing due to high traffic in the days leading up to the flood (Hurst 2011). However, there appears to be poor usage of such flood information, both in terms of council promotion and resident use of it, with neither stakeholder completely proactive about improving flood knowledge.

The findings from Brisbane are similar to those found in other post-disaster research, such as that conducted following a 1998 storm event in Townsville, Australia (King 2000). King wrote that 'people who experienced severe loss of property, experienced that loss precisely because they never expected it' (pg 226), and many Brisbane residents stated their surprise at the impact of the flood and even that such a flood could occur. This again reflects findings from post-earthquake research in New Zealand (McClure et al. 2011). In Brisbane, the construction of Wivenhoe Dam had contributed to some residents' perception that floods could not occur. In Brisbane, not only had it been almost four decades since the last significant flood, the Wivenhoe Dam had been constructed and stricter building controls adopted. These had contributed to complacency about risk, which had been noted as a possible concern following the construction of Wivenhoe Dam, referencing the earlier-constructed Somerset Dam, built during the 1940s, as being seen by residents as having 'flood proofed' Brisbane (Grigg 1977, pg 80). Residents misunderstood the role of both dams, as well as flood frequencies and terminology, assuming another large flood was not due for decades. Not only is this a misunderstanding of flood terminology, it does not reflect the magnitude of the 1974 flood, which was estimated not to be a '1 in 100' flood,

but to have a recurrence interval closer to 40 years (Brisbane City Council 1999). The Queensland Floods Royal Commission (QFCI) highlighted this lack of understanding in its discussion of the Q100 design flood height previously used in Brisbane (QFCI 2012, pg 39). Therefore, even for those who were aware of the risk, their perception of that risk was lower than that quantified by the experts.

Assumptions about changes in flood mitigation, misunderstanding of flood terminology, and low risk perceptions all affect how people 'apply' their flood risk awareness. That their area is a floodplain may not prompt people to take precautionary action if they believe that is the responsibility of others (Paton 2003; McCarthy 2004), and Brisbane residents' comments about the management of Wivenhoe Dam and decisions of the council reflect a belief that preventing the flood was the job of 'someone else'. Burton et al. (1968, pg 18) identified four common responses to uncertainty about hazards: deny the hazard's existence, dismiss the hazard's recurrence, fit it into a pattern (i.e. floods happen every X years), and transfer responsibility to another power (e.g. the government or God). All these attitudes were encountered in Brisbane, particularly with reference to the role of Wivenhoe and the responsibilities of council, state government, and dam management. One recent paper (Burningham et al. 2008) listed two further components to flood risk awareness beyond just knowing the risk: awareness of flood warning systems and methods; and awareness of what actions to take in a flood. These further criteria expand awareness from simply being a piece of knowledge to something that is applied, and reflect the united focus and working together quoted in the NSDR definition of shared responsibility (Attorney General's Department 2009, pg 4).

Residents' experiences were not entirely negative. There was a lot of positivity about the community response, and stories of neighbours assisting each other in both evacuation and clean-up, one resident saying the floods 'gave permission to help each other', while others described an increased sense of community (Bird et al. 2013). The help of local community and other volunteers was also highly valued. The 'Mud Army', the 20,000 + volunteers who helped in the clean-up on the first weekend after the flood (Moore 2011), many travelling in from outside Brisbane, were also well regarded, despite a few concerns about them not being entirely prepared. This spontaneous community response and unity in the wake of the floods demonstrate an already existing desire to work together and share in the rebuilding following natural disasters which the NSDR advocates. What is necessary is to engage with this desire to help following an event and to encourage and involve the community before future events occur.

6 Conclusion

Many residents appeared unsure of what to do in a flood and were unaware of what responsibilities are held by the various stakeholders, let alone themselves. While the sample size was small, there is a clear feeling amongst residents, which was reflected in the media that the Brisbane flood was handled poorly. The Queensland flood enquiry did make criticisms of the Wivenhoe Dam management and of council, and of their management decisions before and during the flood. Yet there was less certainty on what actions residents could take to ensure the risks from future floods are reduced. There is a need for greater communication and support to ensure residents can better understand and fulfil their responsibility to reduce risks. However, the limitations that underlying social vulnerabilities such as age and low income can present to flood preparedness must mediate the level of responsibility residents can assume for their flood risk.

Local and interpersonal linkages are important in a flood event, something reflected in the stories recounted by residents. Other stakeholders, such as SES, council, and insurance, need to be brought into the same discussion as that being held by residents, rather than keeping the structural stakeholders separate from the local community. If the aims of the National Strategy for Disaster Resilience for shared responsibility are to be met, then residents need to be seen as more than end users, both by themselves and by other stakeholders. In Brisbane, some residents responded with uncertainty partly because they did not properly appreciate their risk, but also because they either did not know what to do themselves, or expected another group, such as the government, should or had 'taken care' of it, and that they were protected by Wivenhoe Dam.

This paper found that previous flood experience had no impact on residents' preparedness for flood. Age and income had variable impacts on residents' responses. Social vulnerability factors did have some influence on the results, but poor risk awareness and assumptions about the roles of other stakeholders—local council, emergency services, the insurance industry—also had influenced individuals' decision-making. The NSDR highlights the importance of action from all sectors. For residents to better share in this responsibility, there is a need for an expanded awareness of flood, beyond simply knowing an area is flood-prone, to knowing what will happen in a flood, and what an individual can do for themselves. This also includes better understanding or clearer usage of terminology about the size and frequency of floods to address misperceptions about the '1 in 100' flood. Finally, it is important that the contributions residents can make to their own preparation—such as having flood insurance, using flood-resilient building materials, and having an evacuation plan—are better promoted so that when a flood inevitably occurs, risks are reduced.

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